

GIS in the study of spreading processes of ancient religions

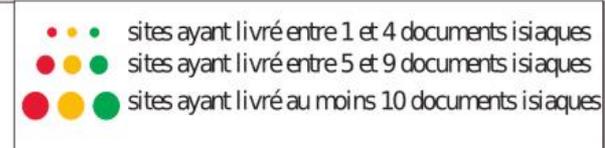
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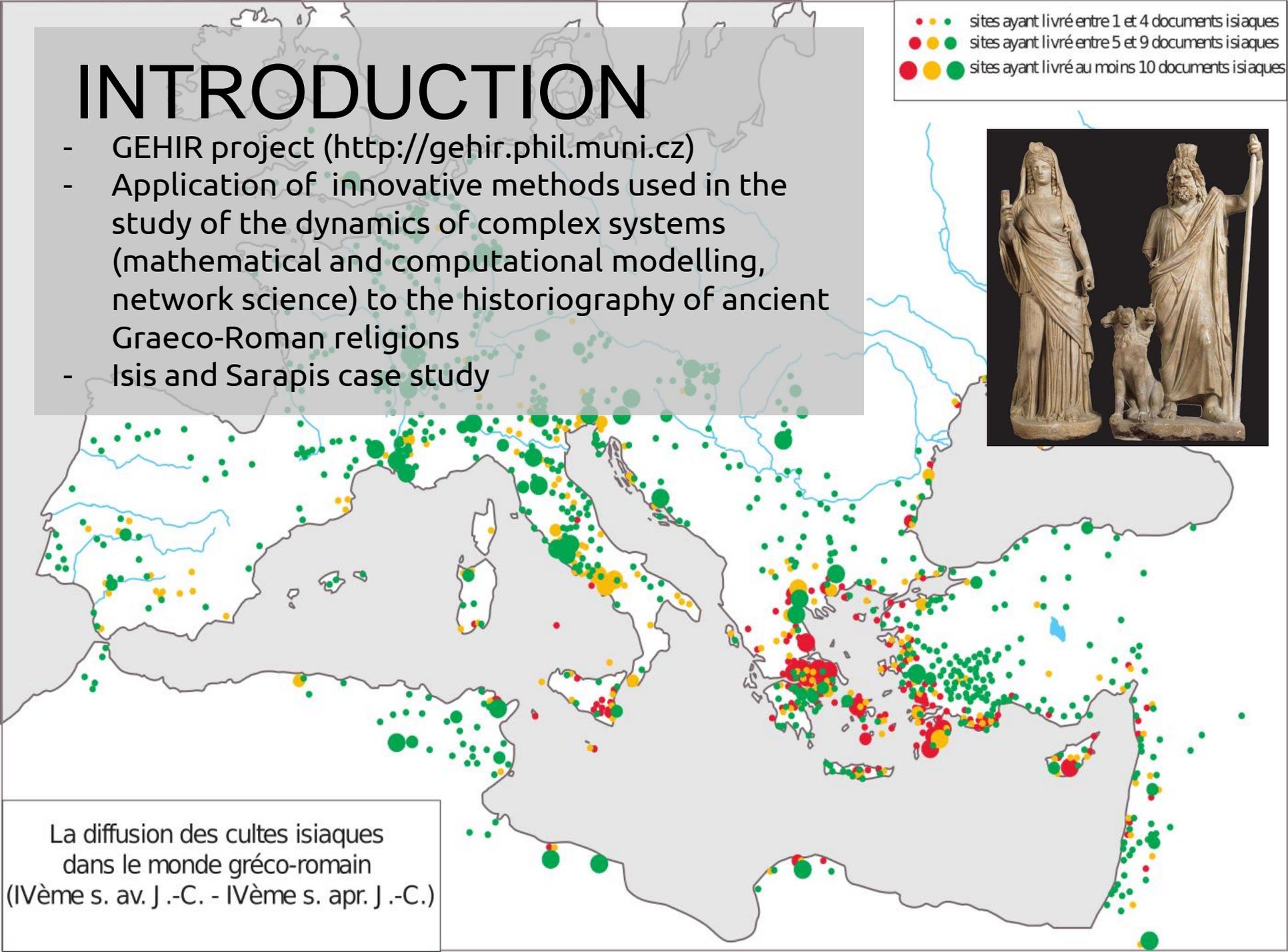
GEHIR GENERATIVE
HISTORIOGRAPHY
OF RELIGION PROJECT
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INTRODUCTION

- GEHIR project (<http://gehir.phil.muni.cz>)
- Application of innovative methods used in the study of the dynamics of complex systems (mathematical and computational modelling, network science) to the historiography of ancient Graeco-Roman religions
- Isis and Sarapis case study



La diffusion des cultes isiaques
dans le monde gréco-romain
(IV^{ème} s. av. J.-C. - IV^{ème} s. apr. J.-C.)

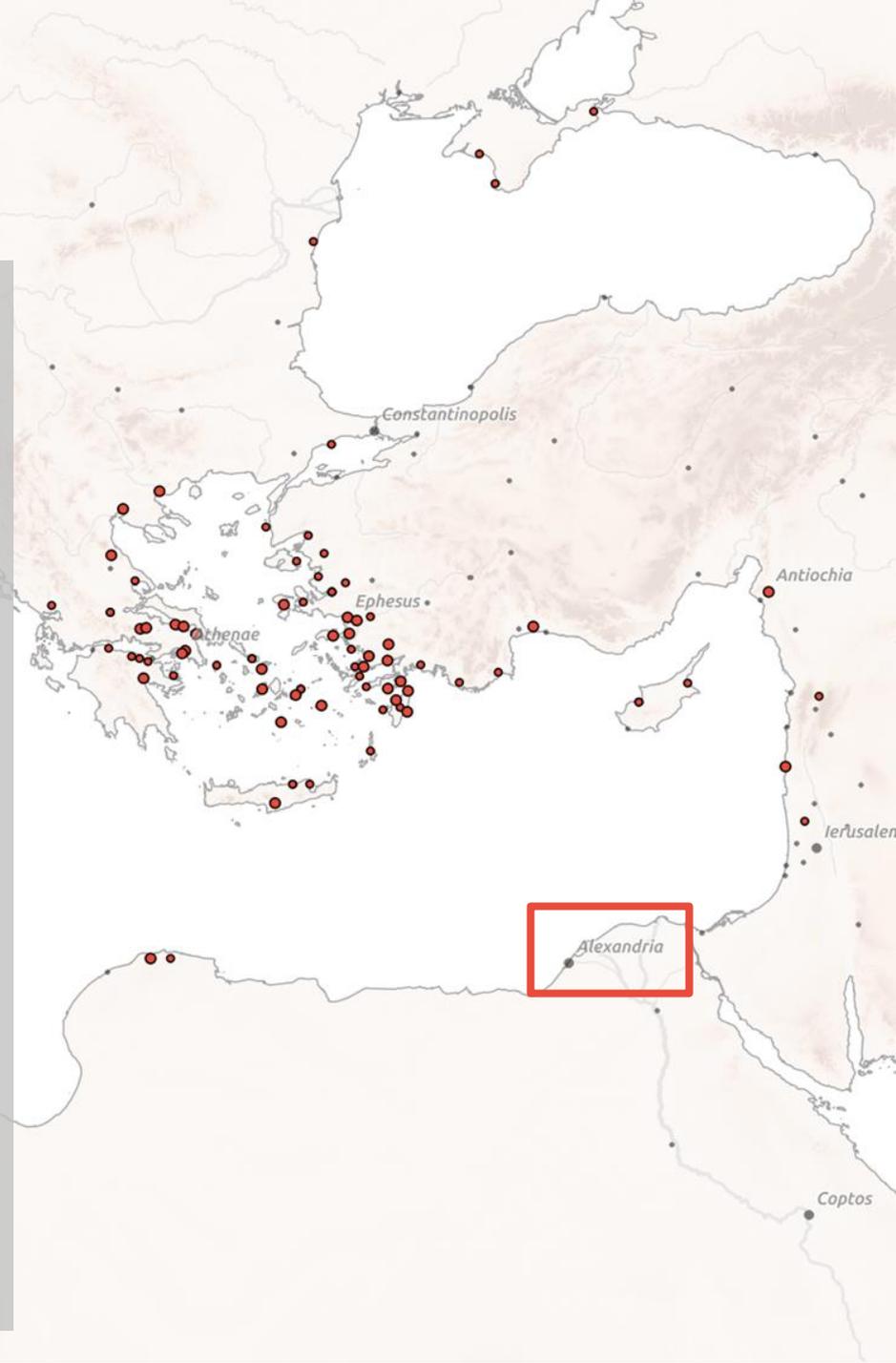


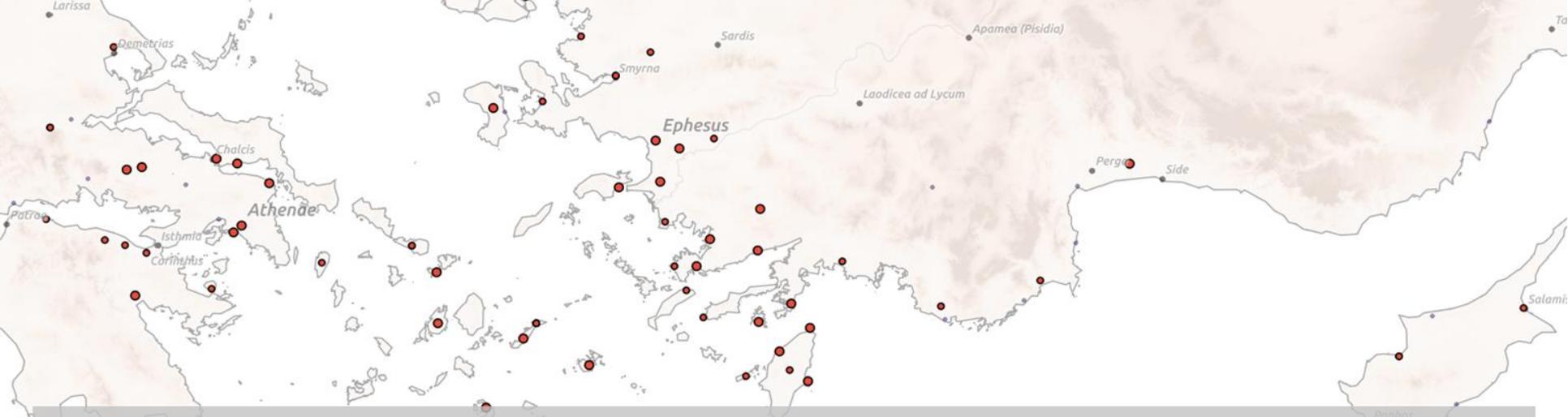
HISTORICAL PROBLEM

Early in the Ptolemaic era (cca 305 - 167 BCE), the Egyptian cults spread successfully to the ports in the ancient Mediterranean.

The main hypotheses in the academic discussion:

- a) **Maritime trade** (Egypt as exporter of grain, Sailors as worshippers)
- b) **Political activity** (Cults of Isis tied to the ruling dynasty)





RESEARCH PROBLEM

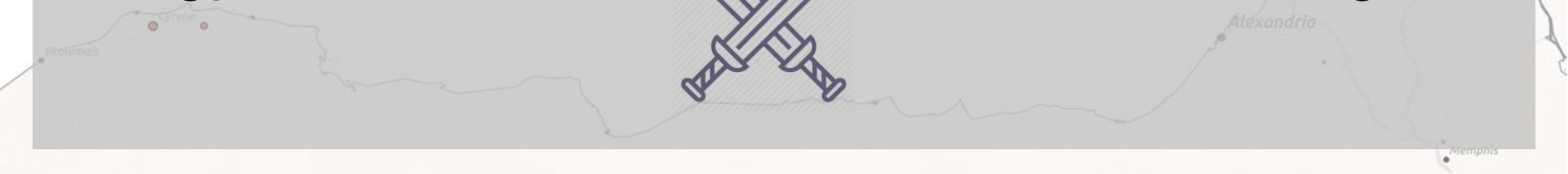
Process

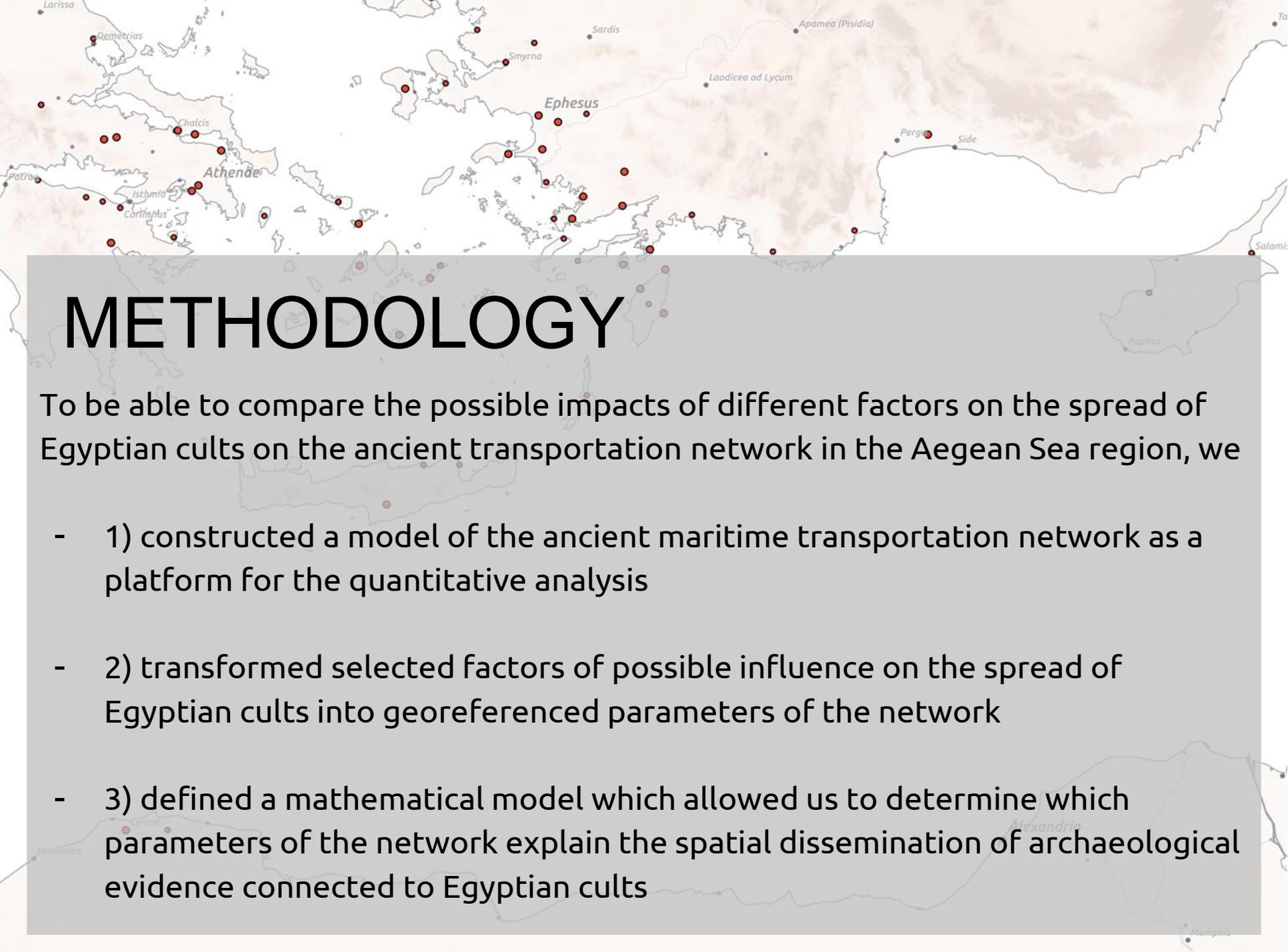


Epicent
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Outcom
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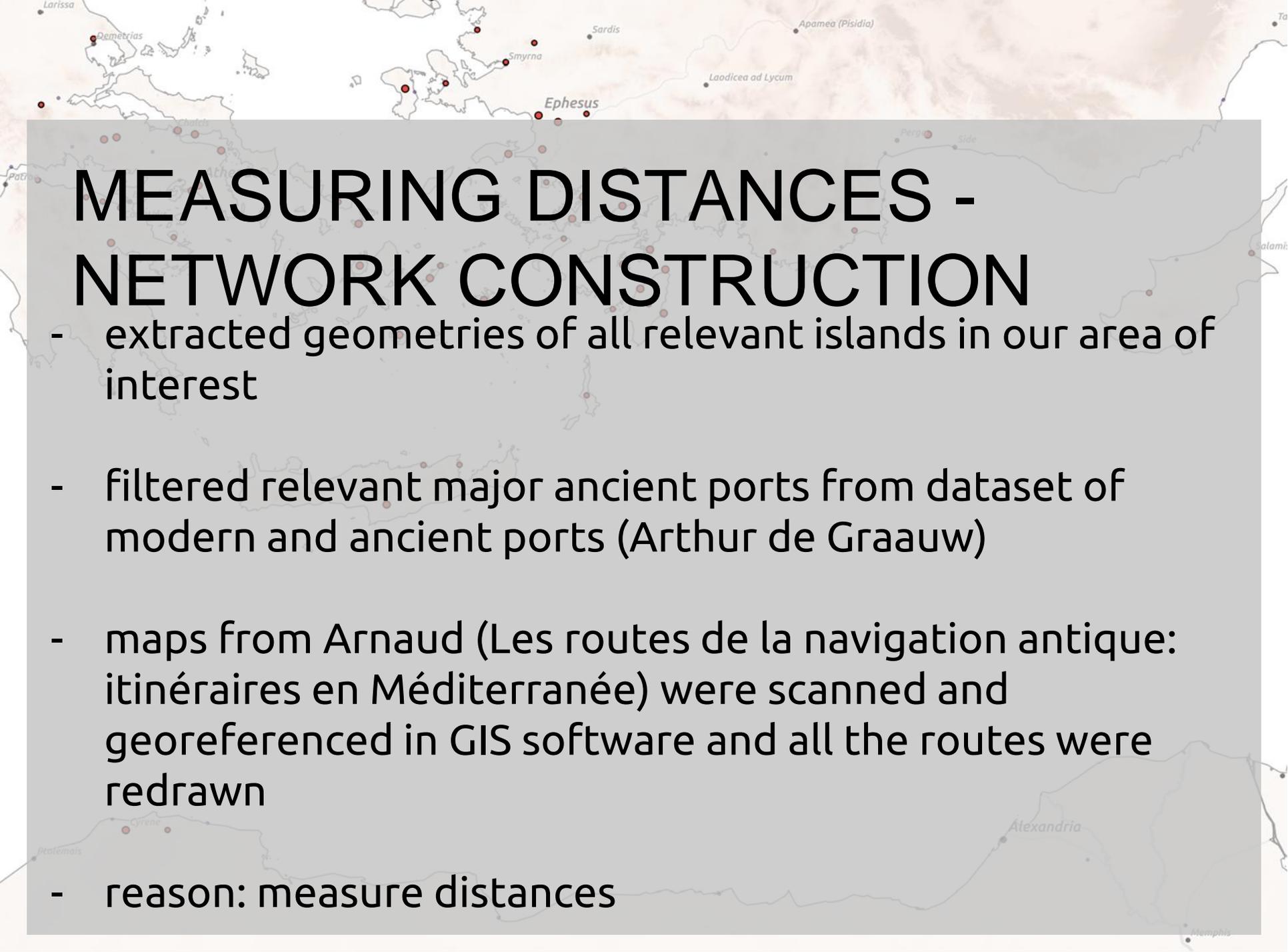


A map of the Aegean Sea region, showing the coastlines of Greece, Turkey, and the islands. Numerous ancient cities are marked with red dots and labeled, including Larissa, Demetrias, Smyrna, Sardis, Apamea (Pisidia), Laodicea ad Lycum, Ephesus, Pergo, Side, Athenae, Chalcis, Patrae, Isthmia, Corinthus, Paphos, and Salamis. A network of lines represents the ancient maritime transportation routes. The map is overlaid with a semi-transparent grey box containing text.

METHODOLOGY

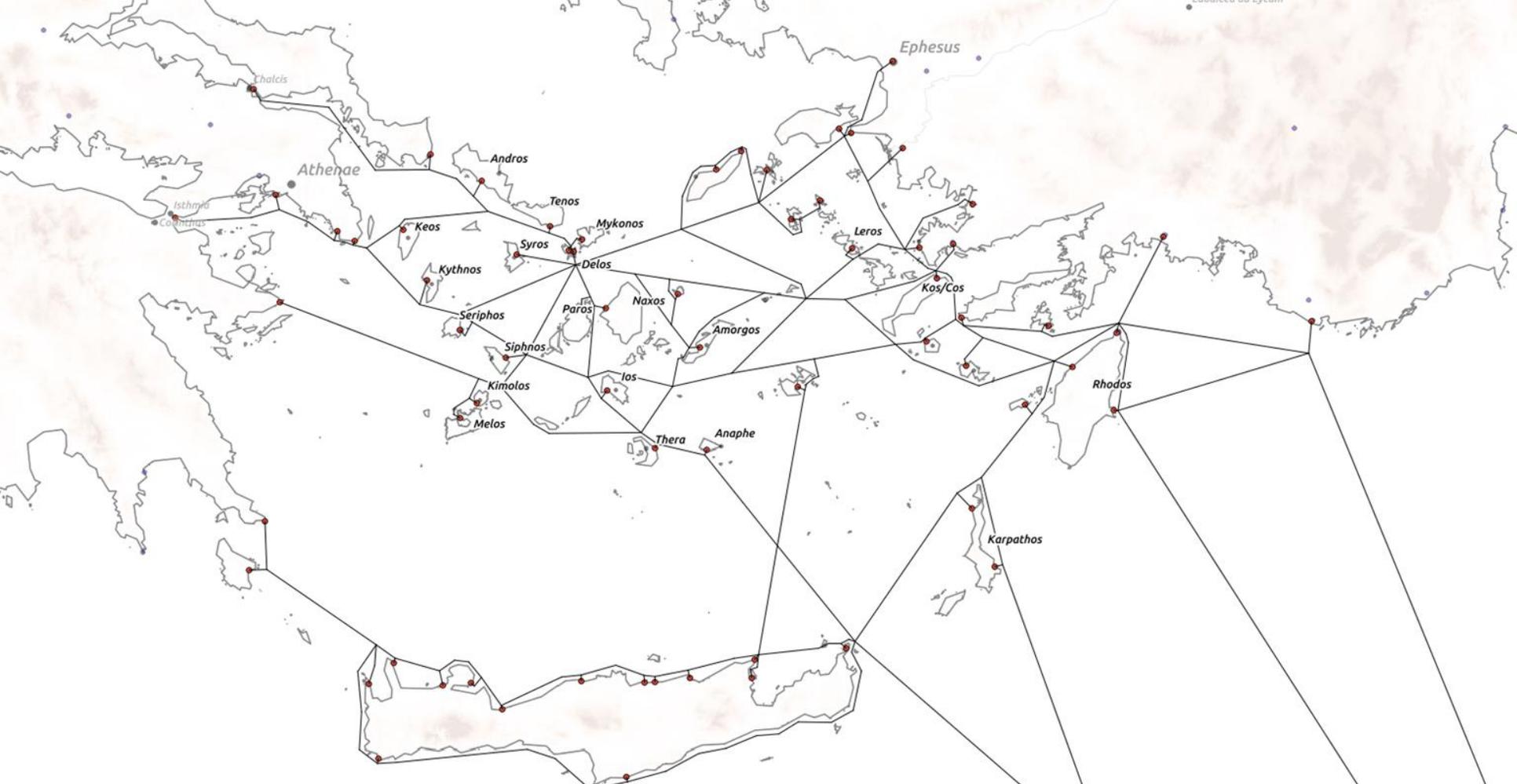
To be able to compare the possible impacts of different factors on the spread of Egyptian cults on the ancient transportation network in the Aegean Sea region, we

- 1) constructed a model of the ancient maritime transportation network as a platform for the quantitative analysis
- 2) transformed selected factors of possible influence on the spread of Egyptian cults into georeferenced parameters of the network
- 3) defined a mathematical model which allowed us to determine which parameters of the network explain the spatial dissemination of archaeological evidence connected to Egyptian cults



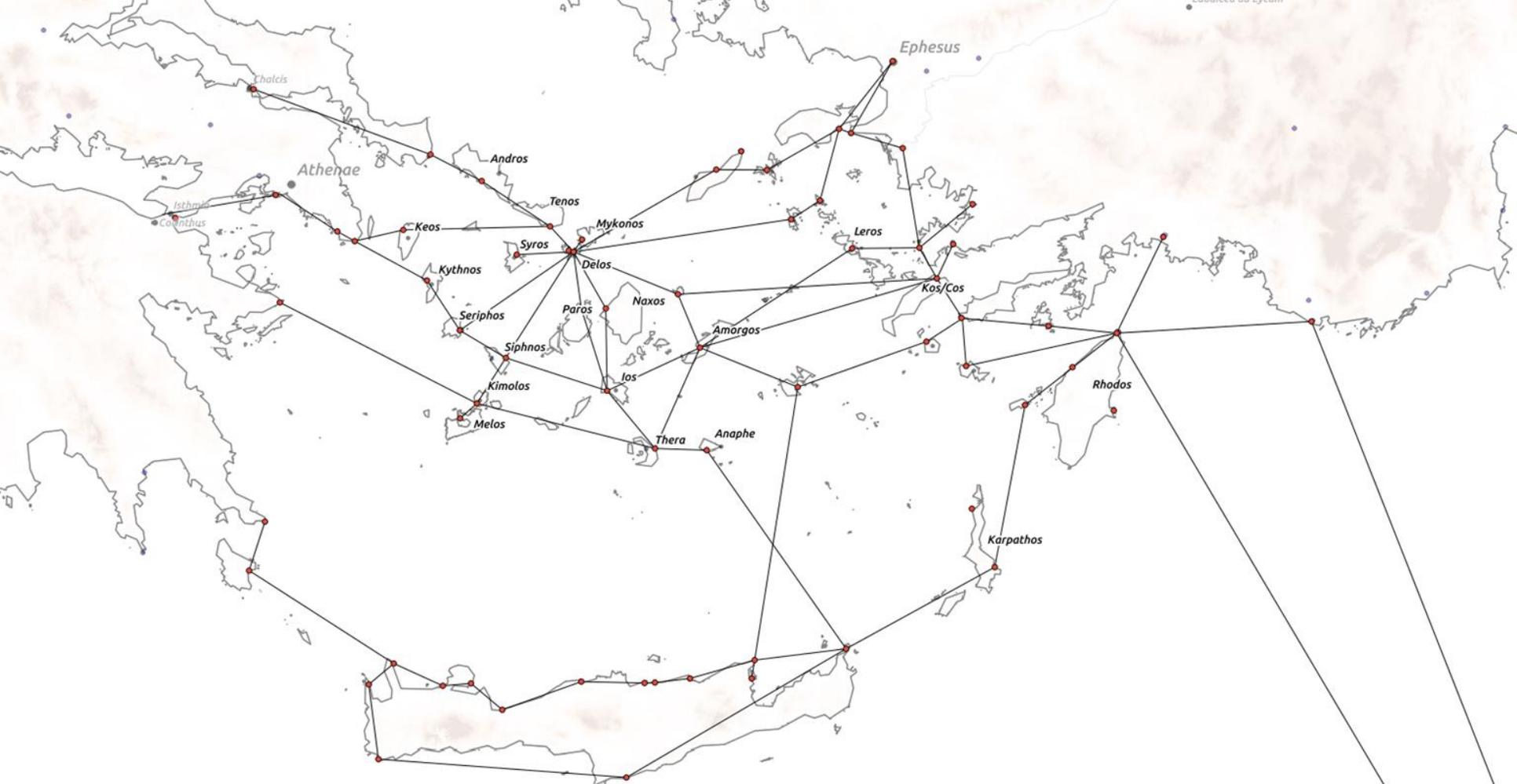
MEASURING DISTANCES - NETWORK CONSTRUCTION

- extracted geometries of all relevant islands in our area of interest
- filtered relevant major ancient ports from dataset of modern and ancient ports (Arthur de Graauw)
- maps from Arnaud (*Les routes de la navigation antique: itinéraires en Méditerranée*) were scanned and georeferenced in GIS software and all the routes were redrawn
- reason: measure distances



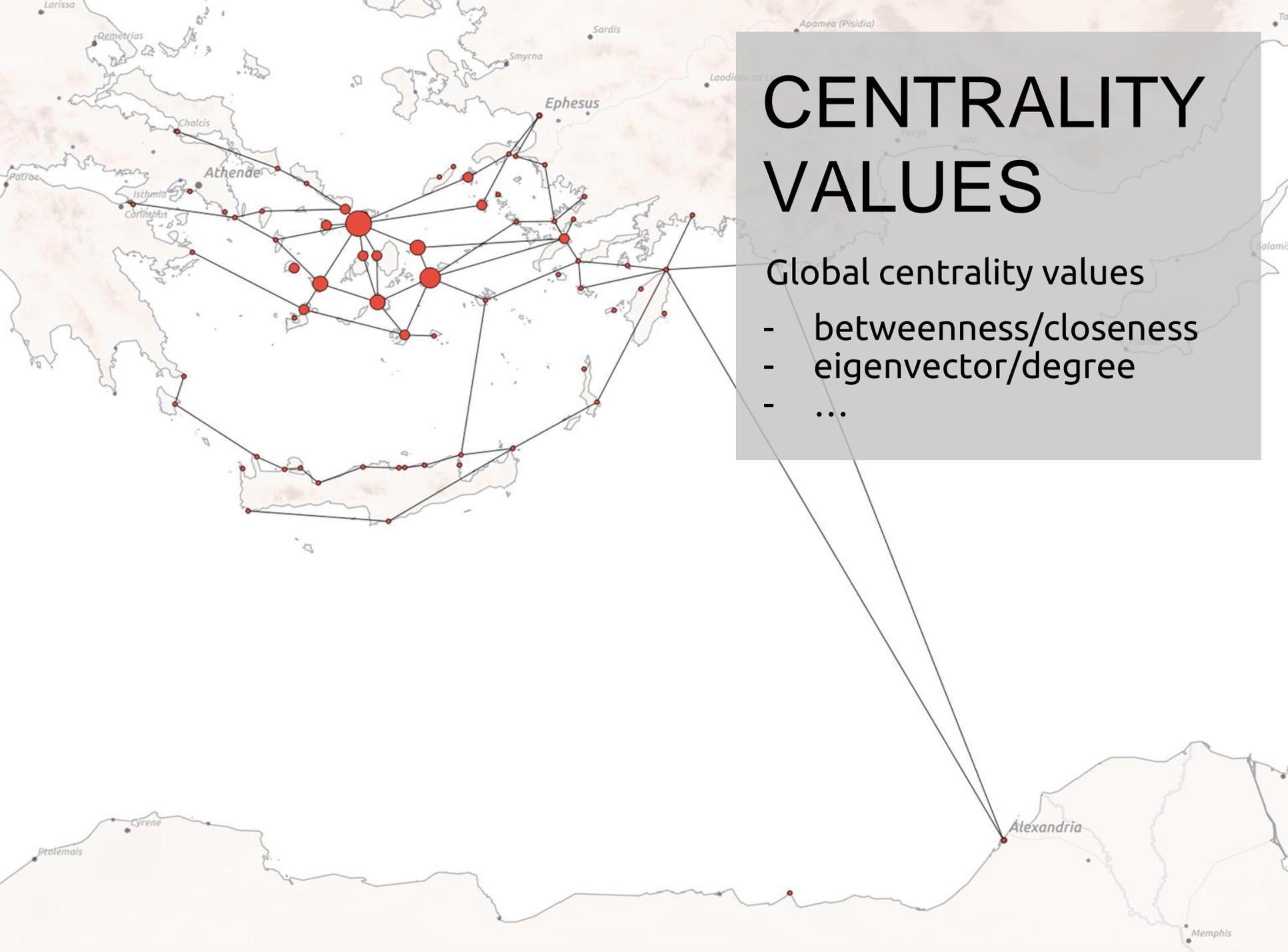
NETWORK CONSTRUCTION - “DYNAMICAL”

- Distance measurements



NETWORK CONSTRUCTION - STATIC

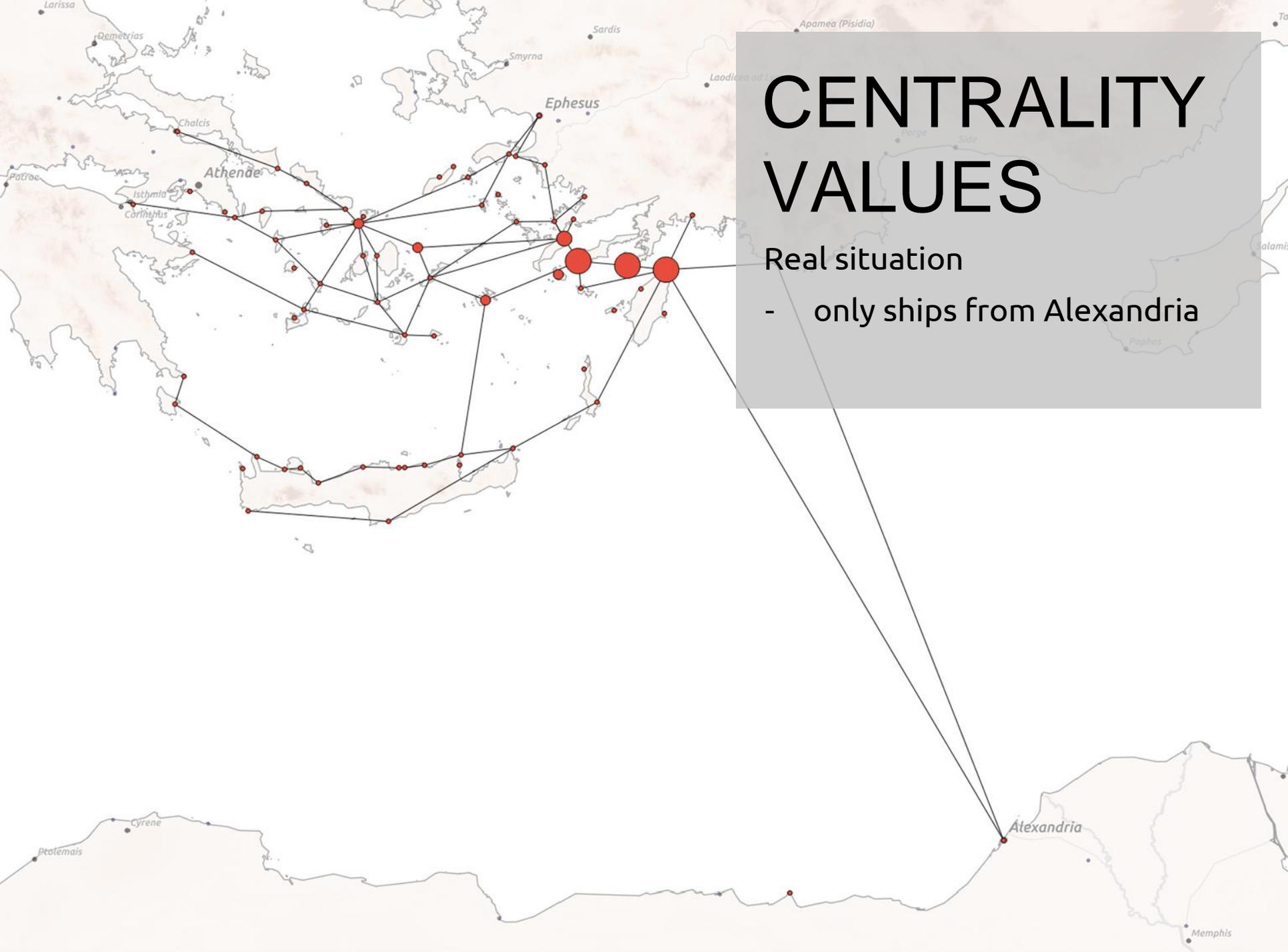
- Centrality values



CENTRALITY VALUES

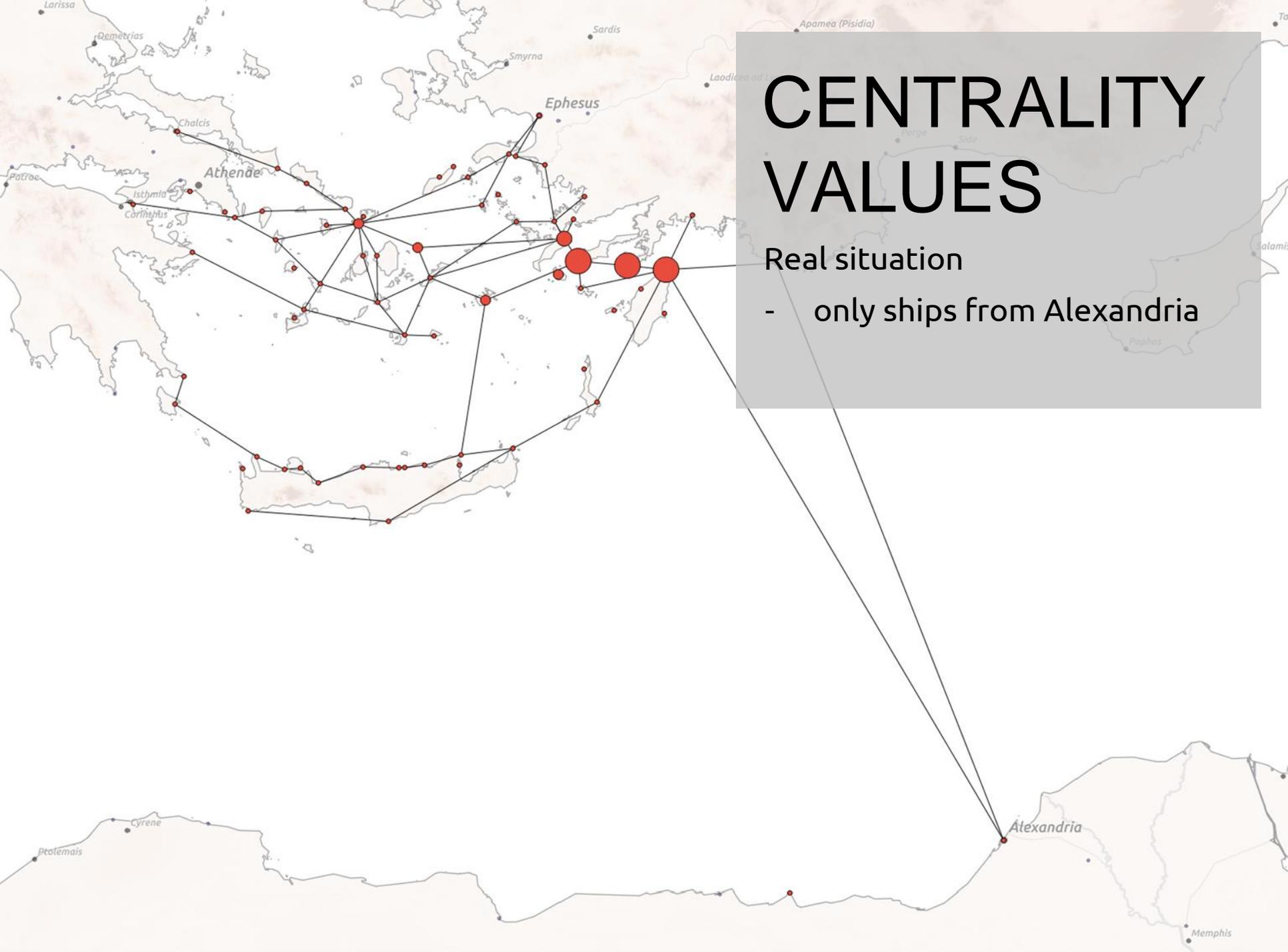
Global centrality values

- betweenness/closeness
- eigenvector/degree
- ...



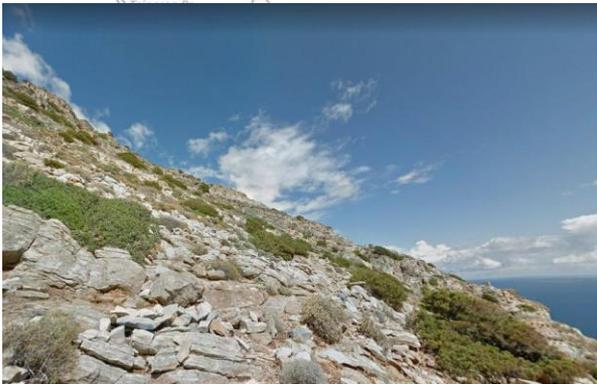
CENTRALITY VALUES

Real situation
- only ships from Alexandria

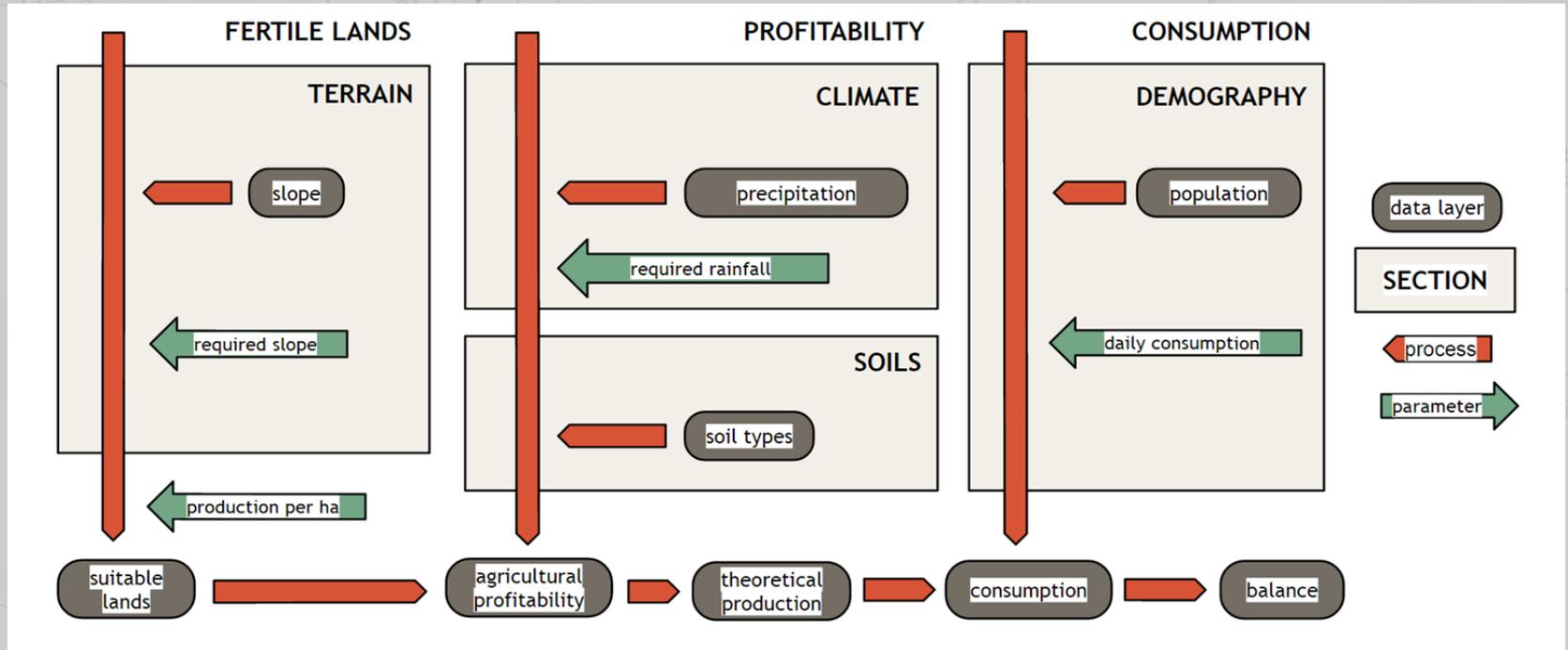


TRADE FACTOR - ENVIRONMENTAL MODEL

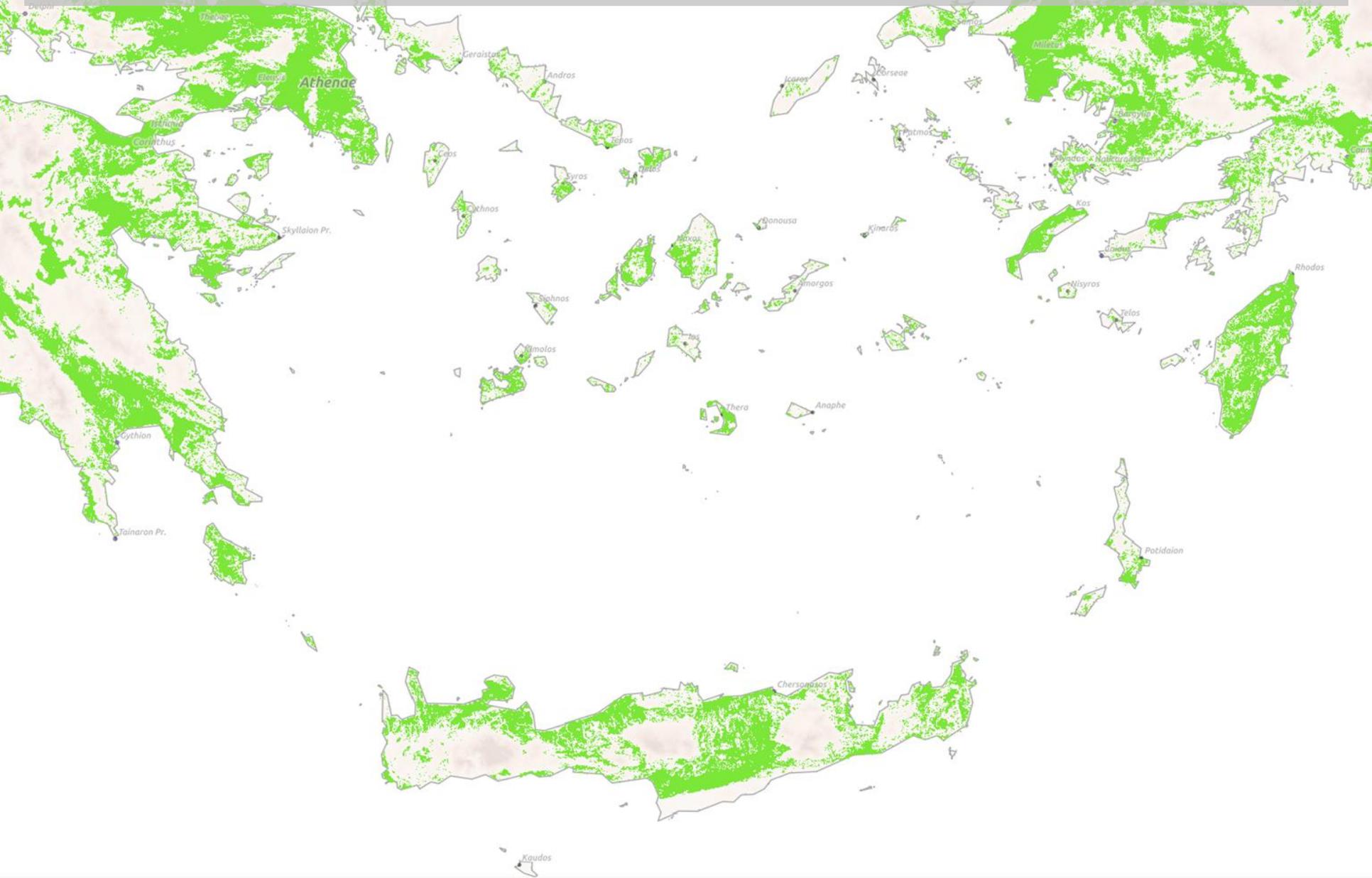
- Assumptions
 - food consumed = food produced + food trade saldo (food imported - food exported)
 - Imported food = food consumed - food produced
 - quantity of consumed food ~ number of inhabitants
 - physical predispositions of island ~ quantity of produced food



MODEL SCHEME



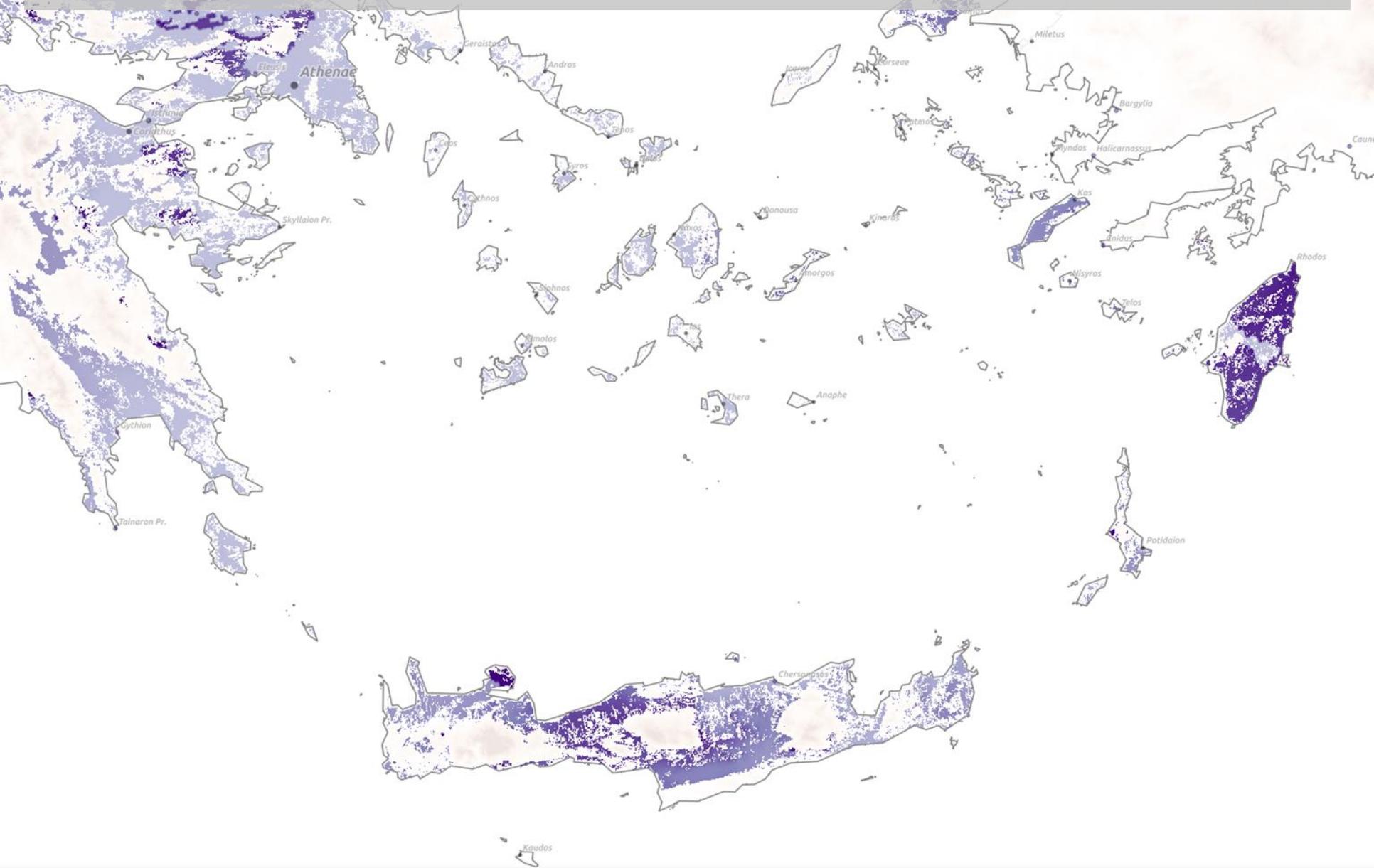
ENVIRONMENTAL MODEL INPUTS - TERRAIN



ENVIRONMENTAL MODELS - RAINFALL

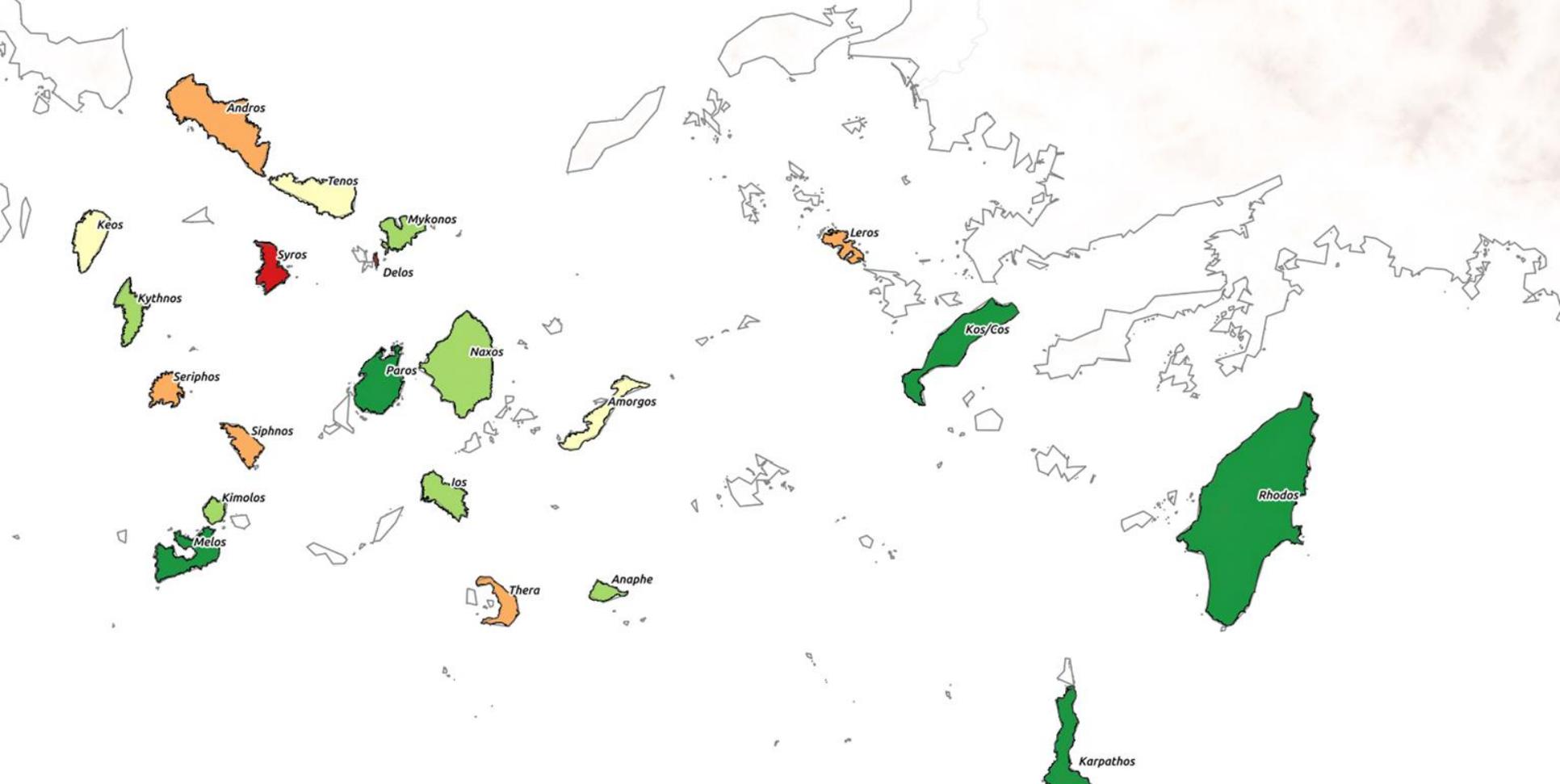


ENVIRONMENTAL MODEL OUTPUTS - PRODUCTION



ENVIRONMENTAL MODEL INPUTS - POPULATION ESTIMATIONS

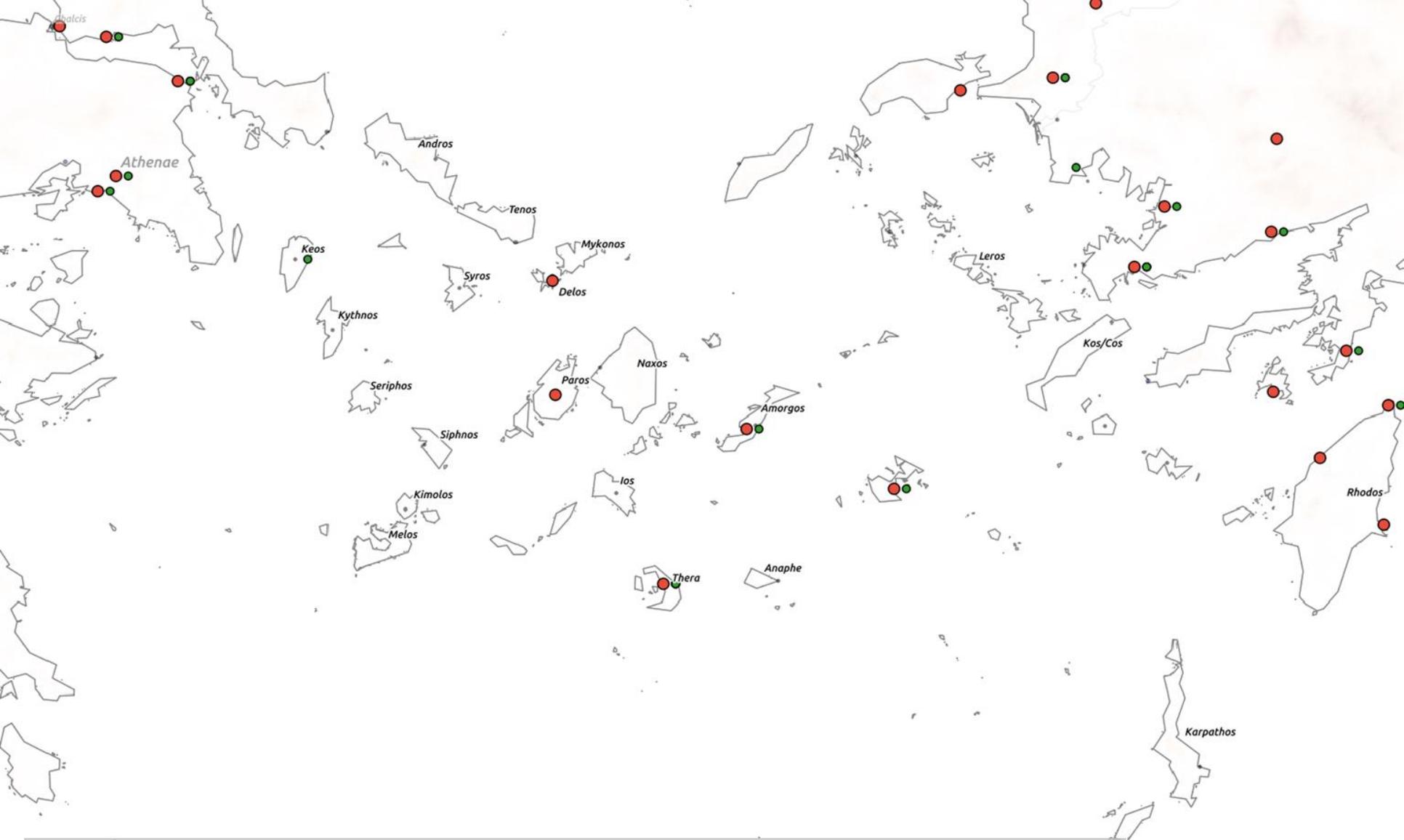
Islands/Estimates	Census	Hansen - polis	Ruschenbusch - tribute
Paros	6504	5625	57600
Tenos	12300	1125	6400
Kythnos	4353	2813	9600
Naxos	17440	3000	21330
Andros	18809	15000	19200
Ios	2171	1013	1600



ENVIRONMENTAL MODEL OUTPUTS - STARVATION RATIO



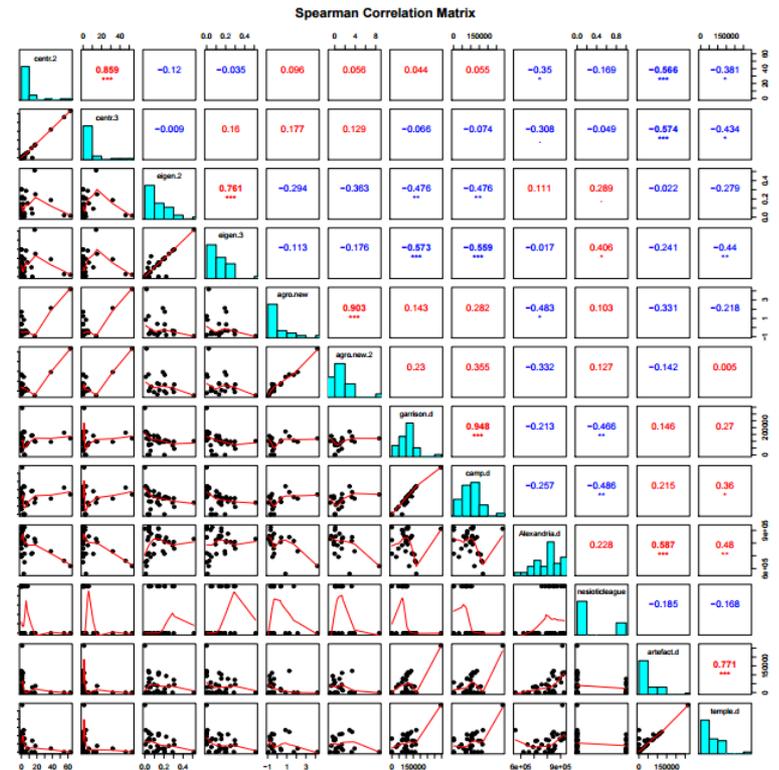
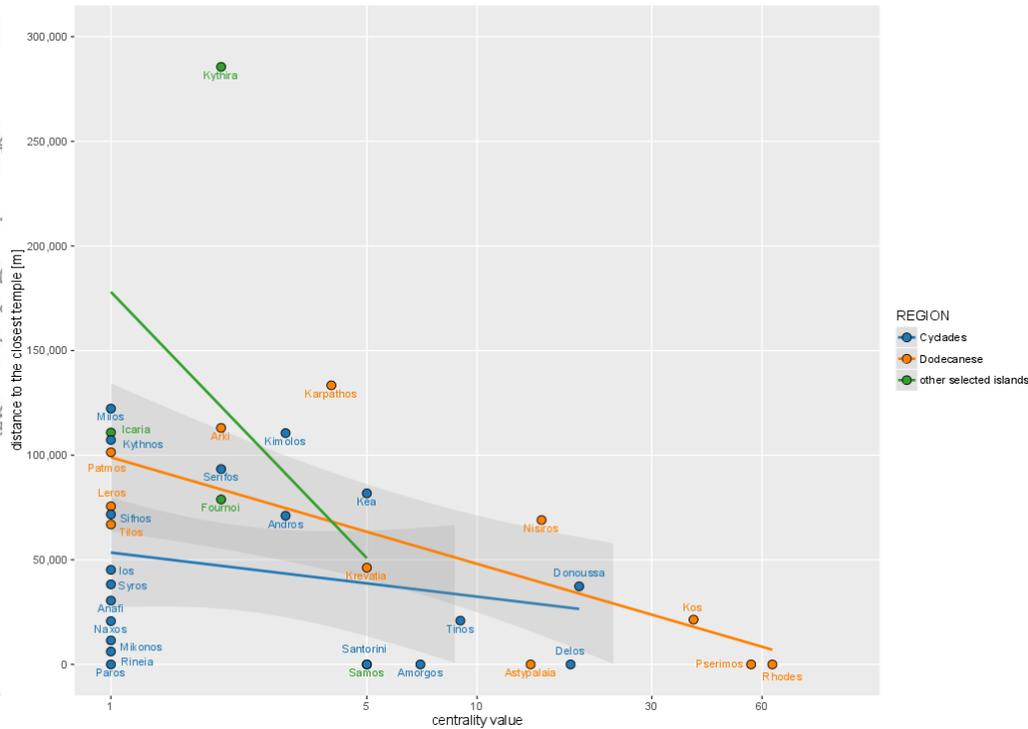
POLITICAL LEVEL - GARRISONS



TEMPLES AND ARTEFACTS

DATA SET

HISTORICAL_N	MODERN_LABE X	Y	ISLAND	REGION	NESIOTICLEA	POPULATIO	STARVATION	ALEXANDRIA_I	EIGEN_3	CENTRALITY	ARTEFACT_D	TEMPLE_D	GARRISON_D
Akrite	Arki	26.736	37.380	Arki	Dodecanese	NO		927,421.00	0.000	0	113055	113055	113055
Amorgos	Amorgos	25.861	36.829	Amorgos	Cyclades	YES	4286	782,810.00	0.285	5	0	0	71220
Anaphe	Anafi	25.768	36.350	Anafi	Cyclades	NO	643	691,906.00	0.049	0	30504	30504	30504
Andros	Andros	24.825	37.814	Andros	Cyclades	YES	18809	903,448.00	0.042	2	57370	71069	70874
Astypalaia	Astypalaia	26.360	36.547	Astypalaia	Dodecanese	NO		715,327.00	0.102	11	0	0	140660
Chalke	Krevatia	27.604	36.218	Krevatia	Dodecanese	NO		650,289.00	0.000	0	0	46219	168005
Cythera	Kythira	23.059	36.218	Kythira	Other	NO		912,564.00	0.000	1	263782	285573	343371
Delos	Delos	25.264	37.397	Delos	Cyclades	NO	5850	833,177.00	0.513	14	0	0	101649
Donousa	Donoussa	25.805	37.097	Donoussa	Cyclades	NO		808,905.00	0.250	15	37319	37319	97314
Ikaria	Icaria-Histoi	26.186	37.633	Icaria	Other	NO		913,284.00	0.000	0	110834	110834	111734
Ios	Ios	25.283	36.723	Ios	Cyclades	YES	2171	756,793.00	0.299	0	45202	45202	45202
Karpathos	Karpathos-Porph	27.213	35.512	Karpathos	Dodecanese	NO	6494	559,503.00	0.008	3	0	133385	170901
Keos	Kea	24.315	37.661	Kea	Cyclades	YES	5019	924,416.00	0.058	2	0	81759	0
Kimolos	Kimolos	24.531	36.789	Kimolos	Cyclades	NO	1655	835,485.00	0.132	1	110560	110560	123895
Korsiai	Fournoi	26.475	37.578	Fournoi	Other	NO		893,215.00	0.154	0	78849	78849	78849
Kos/Cos	Kos	27.289	36.895	Kos	Dodecanese	NO	12965	736,055.00	0.191	32	0	21415	95867
Kythnos	Kythnos	24.392	37.405	Kythnos	Cyclades	YES	4353	873,677.00	0.223	0	77366	107271	77366
Leros	Leros	26.853	37.125	Leros	Dodecanese	NO	6754	790,210.00	0.094	0	45960	75570	110423
Melos	Milos	24.418	36.736	Milos	Cyclades	NO	5310	847,184.00	0.000	0	122259	122259	135593
Mykonos	Mikonos	25.329	37.446	Mikonos	Cyclades	YES	4403	843,857.00	0.130	0	11477	11477	105842
Naxos	Naxos	25.378	37.104	Naxos	Cyclades	YES	17440	808,413.00	0.205	0	20700	20700	96822
Nisyros	Nisiros	27.143	36.617	Nisiros	Dodecanese	NO		721,516.00	0.000	0	29870	69006	143457
Paros	Paros	25.238	37.126	Paros	Cyclades	YES	6504	817,009.00	0.205	0	0	0	105419
Patmos	Patmos	26.546	37.325	Patmos	Dodecanese	NO		915,765.00	0.154	0	101399	101399	101399



MATHEMATICAL ANALYSIS

- Data exploration
- Looking for relevant correlations and patterns
- Complex mathematical model

RESULTS

- Presence of the Ptolemaic garrisons intensifies the presence of the cult (40-50% of variability)
- Agricultural self-sufficiency reduces the presence of the cult (10-15% of variability)
- Higher degrees of centrality intensify the presence of the cult (around 10% of variability)
- The agricultural factor is gaining significance in areas far from garrisons



THANK YOU FOR YOUR ATTENTION!

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